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Non-commercial poultry industries: Surveys of backyard and gamefowl breeder flocks in the United States

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Abstract

The National Animal Health Monitoring System (NAHMS) Poultry '04 study was conducted to better describe non-commercial United States poultry populations, in particular, backyard and gamefowl breeder flocks. To estimate the density of backyard flocks in close proximity to commercial operations, a sample of 350 commercial poultry operations in 18 top poultry producing states was selected from the National Agricultural Statistics Service (NASS) list of poultry operations. A 1 mile radius circle was drawn around each operation, and door-to-door canvassing was conducted within these circles to enumerate premises with all species of birds. Premises with backyard poultry flocks completed a questionnaire focusing on bird health, bird movement, and biosecurity practices. A similar questionnaire, provided in both English and Spanish, was mailed to all members of State affiliates of the United Gamefowl Breeders Association (UGBA) as well as to members of State associations not affiliated with UGBA. An average of 29.4 residences was found within a 1 mile radius of commercial operations, of which 1.9 residences per circle had backyard poultry flocks. Gamefowl breeder flocks were larger, used more health care and biosecurity practices, and moved birds more frequently compared to backyard flocks.

Keywords: Backyard flocks; Gamefowl; Poultry; Biosecurity; National Animal Health Monitoring System; Survey

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1. Introduction

Foreign animal disease introduction into non-commercial poultry, such as backyard and gamefowl flocks, poses risk to the entire United States poultry industry. Oftentimes, foreign disease introductions first occur in backyard flocks. For example, in 1998 Exotic Newcastle Disease of unknown origin was diagnosed in a backyard flock of 48 gamefowl in the Central Valley of California (Crespo et al., 1999). In the 2000 outbreak of Exotic Newcastle Disease in Italy, 219 of the 254 infected premises were backyard flocks (Capua et al., 2002). The outbreak of Exotic Newcastle Disease in California in 2002/2003 illustrated the spillover from backyard flocks to commercial poultry, where poultry from a total of 22 commercial operations were destroyed before the disease was eradicated from California (Whiteford and Shere, 2004). The recent outbreak of High Pathogenicity Avian Influenza (HPAI) H5N1 in Asia has heavily involved the backyard flock sector (Tiensen et al., 2006). The OIE Terrestrial Animal Health Code and the OIE Aquatic Animal Health Code has adopted the concept of compartmentalization as a way to recognize animal populations that are free of certain diseases, without unnecessarily disrupting trade (OIE, 2004). Compartmentalization is based primarily on management practices and biosecurity (Thiermann, 2005) so that commercial poultry and backyard flocks could be considered separate compartments for the purpose of trade. The National Animal Health Monitoring System (NAHMS) Poultry '04 study was conducted to better describe non-commercial poultry populations in the United States, in particular, backyard and gamefowl breeder flocks.

2. Methods

For the purpose of this study, backyard flocks were defined as residences with fewer than 1000 birds other than pet birds (birds not normally used for food and usually housed in cages in the home, such as parrots, cockatiels, parakeets, finches, and canaries). Gamefowl were defined as breeds of chickens such as Kelso, Hatch, Claret, and Roundhead, intended primarily for exhibition or competition and bred for beauty, strength, health, vitality, and longevity.

To estimate the density of backyard flocks in close proximity to commercial operations, a sample of commercial poultry operations in 18 top poultry producing states[1] was selected from producers reporting poultry on the National Agricultural Statistics Service (NASS) 2002 Census of Agriculture. These states accounted for 81% of United States value of poultry production (USDA, 2004). Operations with at least 10,000 chickens or at least 5000 turkeys were selected. The list was sorted by type of operation (broiler, layer, turkey) and geographically. A systematic sample was selected within each state, with the number of operations allocated to each state proportional to the value of poultry production for that state. Based on previous experience with circle surveillance in California and Texas, we anticipated finding on average two to five backyard flocks per circle. Assuming a 70%

[1] Alabama, Arkansas, California, Delaware, Georgia, Indiana, Iowa, Maryland, Minnesota, Mississippi, Missouri, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, Texas, Virginia.

response rate, 350 circles were required to provide the sample size of 500–1000 backyard flocks necessary to estimate prevalences of 50% (±3.1 to 4.4%) and 20% (±2.5 to 3.5%) with 95% confidence (Centers for Disease Control and Prevention, 2005).

Consent was given to NASS by commercial operations to provide their locations to APHIS for the NAHMS study. A 1 mile (1.6 km) radius circle was drawn around each operation, and door-to-door canvassing was conducted within these circles to enumerate premises with any birds. Circles with large numbers of residences were further sampled to accommodate workforce capacity limitations. For subpopulations (neighborhoods) of single-family homes within the circles, the following minimum sampling rules based upon density were used:

- Fewer than 20 homes: contact all.
- Twenty to 200 homes: 20 contacts.
- Two hundred to 600 homes: contact 10%.
- More than 600 homes: 60 contacts.

For apartment buildings and mobile home parks with less than 100 units, 5 randomly selected contacts were made, and for complexes with 100 or more units, 10 randomly selected contacts were made.

These contacts were distributed geographically throughout the neighborhood. Canvassers were instructed not to selectively visit residences where poultry were visible. Premises with birds other than pet birds (backyard flocks) were administered a questionnaire focusing on bird health, bird movement, and biosecurity practices.

A similar questionnaire, provided in both English and Spanish, was mailed to all members of state affiliates of the United Gamefowl Breeders Association (UGBA) as well as to members of gamefowl breeder state associations not affiliated with UGBA. Each state association provided a mailing list to UGBA. Mail labels were generated by the UGBA from each state's membership list independent of NAHMS activities. To ensure confidentiality, names and addresses were not provided to NAHMS. Questionnaires were returned directly to NAHMS, with no identification such as name or address recorded on the questionnaires.

All respondent data were statistically weighted to reflect the population from which they were selected. For the backyard flock component, the initial selection weight was equal to the inverse of probability of selection for each commercial operation. This weight was adjusted for contact rate within each residence type (single-family, apartment, mobile home park) as follows:

$$\text{adjustment contact} = \frac{\text{number residences located within the circle}}{\text{number contacts made}}$$

The weight was further adjusted for non-response within state, residence type, and circle size (number of residences within the circle) strata as follows:

$$\text{adjustment non-response} = \frac{\text{sum of weights for residences that qualified for the survey (backyard flocks)}}{\text{sum of weights for backyard flocks that completed the questionnaire}}$$

$$\text{weight} = \left(\frac{1}{\text{probability of selection}_{\text{commercial}}} \right) \times \text{adjustment}_{\text{contact}} \times \text{adjustment}_{\text{non-response}}$$

For the gamefowl breeder component, the weight was adjusted for non-response within state (or cluster of small states) strata. Because individuals could belong to more than one affiliate organization, they may have been on more than one list. The number of duplicate addresses was estimated from the percentage of undeliverable surveys returned that were duplicate addresses.

$$\text{weight} = \frac{\text{number surveys mailed} - (\text{number undeliverable} + \text{duplicate surveys})}{\text{number of completed surveys returned}}$$

Data were entered into SAS data sets. Validation checks were performed to identify numeric extremes, improper categorical responses, skip patterns not followed, and relational checks. Weighted point estimates and odds ratios were generated using SUDAAN software, which accounts for sampling design and clustering by use of the Taylor linearization method (Shah et al., 1996).

3. Results

For the backyard flock study, locations of 350 commercial operations were provided to NAHMS by NASS, of which 349 circles were canvassed. A total of 10,579 residences were contacted (9839 single-family, 594 apartments, and 146 mobile homes). Of these, 763 had backyard flocks and therefore qualified to participate in the survey and of those qualified, 540 (70.8%) participated.

A total of 10,759 surveys were mailed out to gamefowl breeders, of which 1179 were returned undeliverable, resulting in 9580 delivered surveys. Of the undeliverable surveys, 86 (7.3%) had duplicate addresses. Therefore, assuming a similar percentage of duplication occurred for deliverable surveys, an estimated 8882 surveys went to unique addresses, with 628 completed surveys returned (7.1%).

The density of backyard flocks around commercial operations was low. Although an average of 29.4 residences was found within a 1 mile radius of commercial operations, only 1.9 residences per circle had backyard flocks. Over one-third (38.2%) of commercial operations had no backyard flocks within 1 mile while only 0.3% of commercial operations had 20 or more backyard flocks within 1 mile.

Questionnaire responses for backyard flocks and gamefowl breeder flocks are summarized in Tables 1–3. Gamefowl breeder flocks were larger than backyard flocks (Table 1). Over half of gamefowl breeder flocks had 100 or more birds (OR = 19.6), while over half of backyard flocks had fewer than 20 birds. Gamefowl breeder flocks also used more biosecurity practices such as hand washing and footwear precautions (designated or disposable boots or shoes, footbaths, scrub boots/shoes) compared to backyard flocks.

Gamefowl breeder flocks moved birds off and onto the premises more frequently than backyard flocks. Few backyard flocks (3.6%) had moved birds to a location with other birds

Table 1
United States NAHMS Poultry Survey 2004: Percentage of backyard flocks and gamefowl breeder flocks with the following flock characteristics, and odds of gamefowl breeder flocks having the characteristic compared to backyard flocks

Characteristic	Backyard percent	Gamefowl percent	Odds ratio	95% CI
Flock size (number of birds on day of survey)				
100 or more	8.5	64.6	19.6[a]	10.5–36.6
20–99	33.0	30.3		
1–19	58.5	5.1		
Biosecurity practices				
Any footwear-related precautions in bird area	11.4	52.2	8.5	5.5–13.2
Wash hands before handle birds	18.1	58.1	6.2	4.2–9.3
Wash hands after handle birds	56.5	71.8	2.0	1.3–2.9
Allow visitors in poultry area	46.5	46.3	0.99	0.69–1.43
Wild bird feeder on property	40.0	15.3	0.27	0.18–0.40
Bird movements in the previous 12 months				
Any new flock introductions	36.6	51.5	3.8	2.1–7.1
Sold or gave away live birds	17.8	70.9	11.3	7.6–16.7
Birds taken to location with other birds and returned	3.6	69.9	62.7	33.8–116
Source location of new additions[b]				
Within same county as premises	60.0	58.5	0.94	0.58–1.6
Outside premises county but within State	29.3	53.4	2.8	1.7–4.6
Outside State but within the U.S.	22.0	38.1	2.2	1.2–4.1
Outside the U.S.	0.2	1.2	6.2	0.63–61.1
Destination location for birds sold or given away[c]				
Within same county	80.2	74.8	0.73	0.36–1.5
Outside premises county but within State	37.4	56.8	2.2	1.3–3.8
Outside State but within U.S.	7.7	33.7	6.1	2.1–17.7
Outside U.S.	1.9	14.3	8.6	1.2–64.4

[a] Reference level = flock size less than 100 birds.
[b] For flocks that had new additions in the previous 12 months.
[c] For flocks that sold or gave away birds in the previous 12 months.

and then returned, compared to 69.9% of gamefowl breeder flocks. Bird introductions from outside the United States were rare for both gamefowl breeder flocks and backyard flocks (1.2% and 0.2% of flocks with new additions, respectively). Exports were more common than imports; 14.3% of gamefowl breeder flocks that sold or gave away birds sent birds outside of the United States.

Only 13.4% of backyard flocks reported any health problems in the previous 3 months compared to 61.3% of gamefowl breeder flocks (Table 2). The most common health events reported by gamefowl breeder flocks were external parasites (47.1% of flocks) and respiratory problems (23.9% of flocks).

Gamefowl breeder flocks used more health care practices compared to backyard flocks. Over half (58.6%) of gamefowl breeder flocks vaccinated birds compared to less than 3% of backyard flocks. Use of a veterinarian was low for both gamefowl breeders (18.2%) and backyard flocks (2.9%).

Table 2
United States NAHMS Poultry Survey 2004: Percentage of backyard flocks and gamefowl breeder flocks having the following bird health problems and health practices and odds of gamefowl breeder flocks having the characteristic compared to backyard flocks

	Backyard percent	Gamefowl percent	Odds ratio	95% CI
Health problems (previous 3 months)				
Diarrhea	1.6	8.5	5.8	2.3–14.8
Respiratory (nasal/eye discharge, cough/sneeze, swollen sinuses)	2.7	23.9	11.3	4.8–26.4
Neurologic (lack of coordination, weakness)	0.8	3.2	4.0	0.83–19.0
Weight loss	1.9	9.7	5.4	2.1–14.4
Feed refusal/depression (droopy birds)	1.6	7.8	5.1	1.8–14.2
Sudden decreased production not related to molting (reduced egg laying, hatching rate, no weight gain)	1.3	2.1	1.7	0.51–5.6
Unexplained death loss	3.1	6.0	2.0	0.93–4.1
Lameness	1.4	4.2	3.0	1.3–7.3
External parasites (mites, lice, etc.)	5.5	47.1	15.2	6.7–34.7
Other	2.9	3.3	1.1	0.42–3.2
Any of the above	13.4	61.3	10.2	6.5–16.0
Use of veterinary service (previous 12 months)	2.9	18.2	7.4	3.6–15.2
Vaccinated any birds (previous 12 months)	2.8	58.6	49.7	22.2–111

Nearly half of gamefowl breeders (46.5%) had raised birds by their families at the same location for 20 or more years, while a similar percentage of backyard flocks (43.0%) had raised birds at their location for less than 5 years (Table 3). Both gamefowl breeders and backyard flock producers ranked fun/hobby highest as the reason for having birds.

Table 3
United States NAHMS Poultry Survey 2004: Percentage of backyard flocks and gamefowl breeder flocks with the following producer characteristics and odds of gamefowl breeder flocks having the characteristic compared to backyard flocks

Characteristic	Backyard percent	Gamefowl percent	Odds ratio	95% CI
Reason for having birds ranked high or very high				
Family tradition	46.5	82.1	5.3	3.7–7.7
Fun/hobby	68.9	93.1	6.1	3.8–9.9
Extra income	6.8	36.0	7.7	4.7–12.5
Food	42.4	17.4	0.29	0.20–0.42
Lifestyle/ambiance	44.8	87.0	8.3	5.5–12.9
Clubs/social interactions (4H, avian organizations)	4.4	40.3	14.7	8.7–24.8
Other reasons to have birds	6.6	28.3	5.6	3.1–10.2
Number of years birds raised by family on premises				
20 or more	22.3	46.5	3.0[a]	2.1–4.4
5–19	34.7	40.7		
Less than 5	43.0	12.8		

[a] Reference level = less than 20 years.

4. Discussion

Although reasonably complete lists of commercial operations exist, lists of non-commercial operations in the United States are limited, so designing a study in which population inferences could be generated posed a unique challenge. The study design for the backyard flock component allowed for population inferences to be made regarding population density, characteristics and practices of backyard flocks within 1 mile of commercial operations in 18 states, however, the number and distribution of backyard flocks outside of this inference population could not be estimated. The information generated by this study design is useful to assess the potential risk that backyard flocks pose to commercial operations.

The backyard flock survey was conducted in areas of the country with the highest density of commercial poultry. The broiler industry is located primarily in the southeastern United States and the eastern seaboard, while the layer industry is located in the Midwest and Great Lakes regions of the country. The gamefowl breeder survey was administered to gamefowl breeder association members, located primarily in the southcentral United States.

Although individual birds move frequently, at the flock level the gamefowl breeder population is relatively stable (nearly half of flocks had been in the same location for over 20 years), whereas there is more turnover in the backyard flock population. A list of gamefowl breeder flocks would be easier to maintain, whereas a backyard flock list may not be feasible to maintain. Because backyard flocks are less organized (i.e., do not belong to associations), they are also more difficult to find in the first place. An up-to-date list frame could facilitate surveillance as well as future studies.

This study identified a lack of biosecurity practices, such as footwear precautions, hand washing, and visitor restrictions, utilized by backyard flocks. Additionally, backyard flocks commonly had wild bird feeders on the property that could encourage congregation of wild birds and are a potential source of disease introduction. These results are similar to findings from other studies. A 2003 study in Denmark identified a low level of biosecurity in free-range flocks, mainly due to insufficient hygiene practices (Bojesen et al., 2003). A study of backyard poultry flocks was carried out in California in 1991 which included 62 premises within 1 mile of 22 meat turkey flocks (McBride et al., 1991). Although much smaller in scale and more restricted in geography, this study had similar results to the Poultry '04 study such as flock size (mean 35), allowing visitors, few reported health problems, and lack of use of a veterinarian or vaccination of birds. Due to the scope of the 1991 study, comparisons with our study are limited, but the results suggest that management practices of backyard flocks may have remained relatively unchanged over the past decade.

This study was a first attempt to gain some knowledge about characteristics and practices of the United States gamefowl industry. The gamefowl breeder segment of the industry was selected for this endeavor because of the existence of a sampling frame (membership mailing lists for state organizations) and the UGBA was willing to help facilitate a mail survey. Despite assurances of confidentiality and promotional efforts by the UGBA directed toward its membership, the response rate to the survey was low, ranging from 3% in Texas to 25% in Colorado. Although analysis weights were adjusted for non-response within state (or cluster of small states) to account for these differences in response

rate, respondents may not be representative of the entire population of gamefowl breeders, and the effect that the potential bias may have on prevalence estimates and odds ratios cannot be measured. Nevertheless, 628 gamefowl breeder flocks did participate, allowing some insights into a previously unstudied industry. Inferences to gamefowl owners other than breeders cannot be made from this study.

Gamefowl breeder flocks experienced more health problems compared to backyard flocks. This is likely related to larger flock size and therefore more birds in which health events could occur. Also, since gamefowl breeders move more frequently than backyard flocks, particularly to shows and other events where other birds are present, there is increased opportunity for exposure to disease.

Gamefowl breeders used more health care practices compared to backyard flocks, which may be related to knowledge level and availability of resources. Backyard flocks indicated a lack of availability for health care such as access to veterinary care, medications, and vaccinations. Because our sample for gamefowl breeder flocks came from membership of UGBA, this group had access to information resources such as newsletters, magazines, and shows as a benefit of membership, that were not available to backyard producers.

Gamefowl breeder flocks used more health care and biosecurity practices and moved more frequently compared to backyard flocks. Therefore, efforts to prevent or control disease spread within the gamefowl breeder industry would best be focused on movement and exposure of birds to other birds, while backyard flocks may benefit more from educational campaigns regarding biosecurity practices.

Although backyard flocks practiced poor biosecurity in general, they moved birds very infrequently. Additionally, the density of backyard flocks around commercial operations was generally low. Therefore, other than a very few locations with high density of backyard flocks, commercial operations that practice good biosecurity would seem to be at fairly low risk of disease transmission from backyard flocks.

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